# *International Biological Threat Reduction at Sandia*

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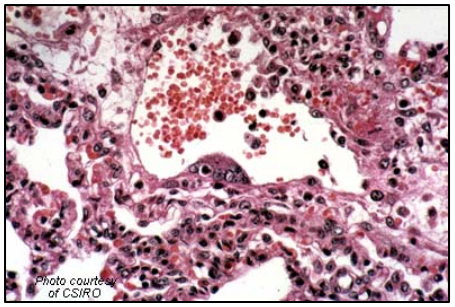
**www.biosecurity.sandia.gov**

**Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.**

International BIOLOGICAL THREAT REDUCTION

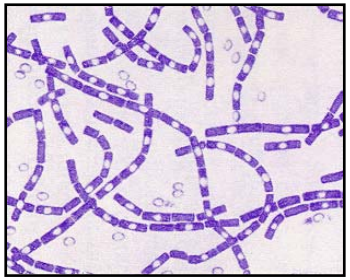
# Outline

- Sandia's International Biological Threat Reduction program
- Historical biological weapons threat and how the US Government has addressed it
- Evolution of the biological threat and the recent development of new threat reduction programs

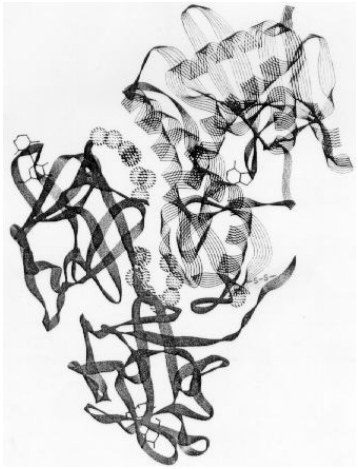



*Nipah virus*

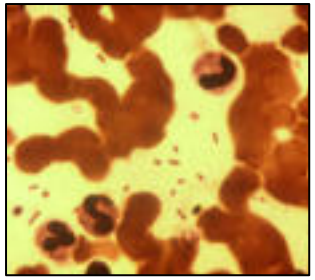
*Francisella tularensis*



*Bacillus anthracis*



*Ricin*



*Yersinia pestis*

*Smallpox virus*

# Sandia's International Biological Threat Reduction (IBTR) Program

- **Sandia IBTR mission**
  - **Enhance United States national security by reducing biological threats globally**
- **Biological threats to US national security**
  - **Bioterrorism**
  - **Biological weapons proliferation**
  - **Naturally occurring highly infectious disease**

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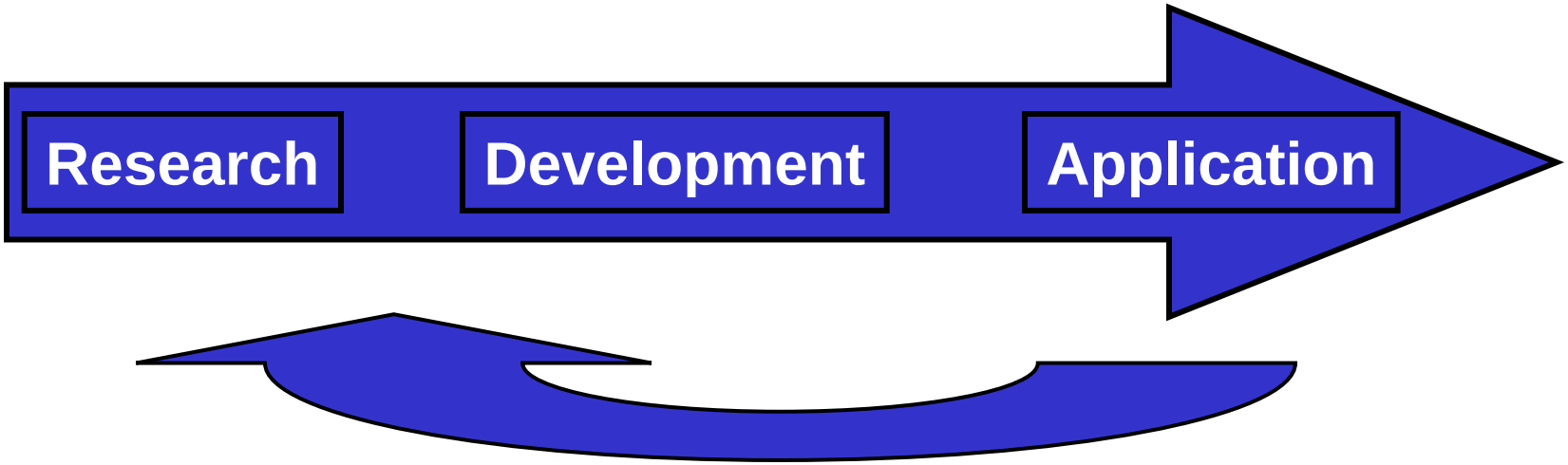
# Technology Spectrum




**Technical advisers to policy makers in science and international security**

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# New Sandia Department in 2004

- **Multidisciplinary professional staff**
  - **Biophysics/chemistry/toxinology**
  - **Microbiology/bacteriology**
  - **Large animal veterinary medicine/physiology**
  - **Small animal veterinary medicine/epidemiology**
  - **Cellular biology/genetics**
  - **Toxicology**
  - **International security and BW nonproliferation expertise**
  - **Physical protection, security and counter-terrorism expertise**
  - **Information security/information technology expertise**
  - **Software engineering**
  - **Multiple foreign languages**
  - **MBA/project administration**

- **Rely on extensive technical reach-back capability at Sandia**
  - **Active collaborations with 4200, 5900, 6200, 6400, 6900, 8300**

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# International Engagement To Date

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# History of Biological Weapons

- **1346: Tartar invaders catapulted plague-infected bodies over city walls during siege of Kaffa**

- **1763: British soldiers distributed blankets used by smallpox victims to Native Americans during French and Indian Wars**
- **World War I**
  - **Germany, France - anti-livestock sabotage**

- **World War II – 1972**
  - **Japan, USSR, US, UK, Canada**
    - **Japanese use against Chinese targets**
    - **Alleged USSR use against German soldiers**
- **Intent and effect of BW use was tactical, not strategic (influence battle, not war)**

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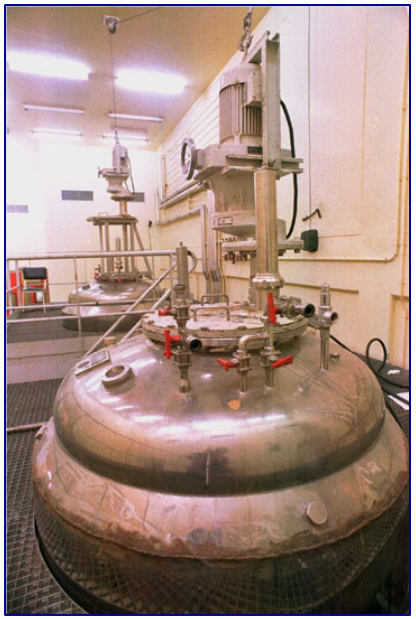
# Biological Weapons Convention (BWC)

- **Prohibits the development, production, and stockpiling of biological weapons agents, toxins, equipment, and means of delivery by State Parties**
- **Opened for signature April 1972; entered into force March 1975**
  - **171 State Parties (16 signatories have not ratified; 23 non-signatory nations)**
- **No provisions for verification of compliance**
  - **Dual-use nature of biological materials, technologies, and expertise present significant challenges**
  - **Extreme difficulty of discerning between legitimate and illegitimate biological research**



***Fermentation Vessels***

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# Failure of the BWC

- **Biopreparat: The civilian arm of the Soviet biological weapons program**
  - **Established *after* Soviet accession into the BWC**
  - **40 – 50 facilities with up to 60,000 employees**

***Production Facility in Kazakhstan***

- **Other incidents**
  - **Iraq research program prior to 1991 Gulf War**
  - **Assassination of Bulgarian dissident**
  - **Alleged South Africa program to assassinate anti-apartheid activists**

***Munitions in Iraq***

- **Other suspected BW programs since 1972**
  - **Iran, North Korea, Syria, Sudan, Cuba**

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# Terrorist Uses of Biological Weapons

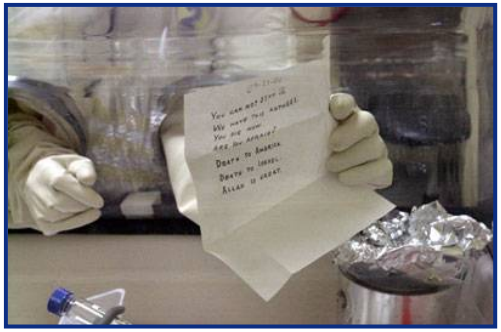
- **Rajneeshees – 1984**
  - **Contaminated restaurant salad bars in The Dalles, Oregon with salmonella spp. bacteria**

***Bhagwan Shree Rajneesh***

***Aerosolization of Bacillus anthracis and botulinum toxin by Aum Shinrikyo***

- **Aum Shinrikyo – 1990s**
  - **Aerosolized and disseminated biological agents in Tokyo**
    - **Vaccine strain of *Bacillus anthracis***
    - **Inactive strain of *Clostridium botulinum***

- **US anthrax attacks – 2001**
  - **Highly refined: 4-7 letters contaminated over 60 different sites**
  - **Highly virulent: killed 5, wounded 21**



***Amerithrax***

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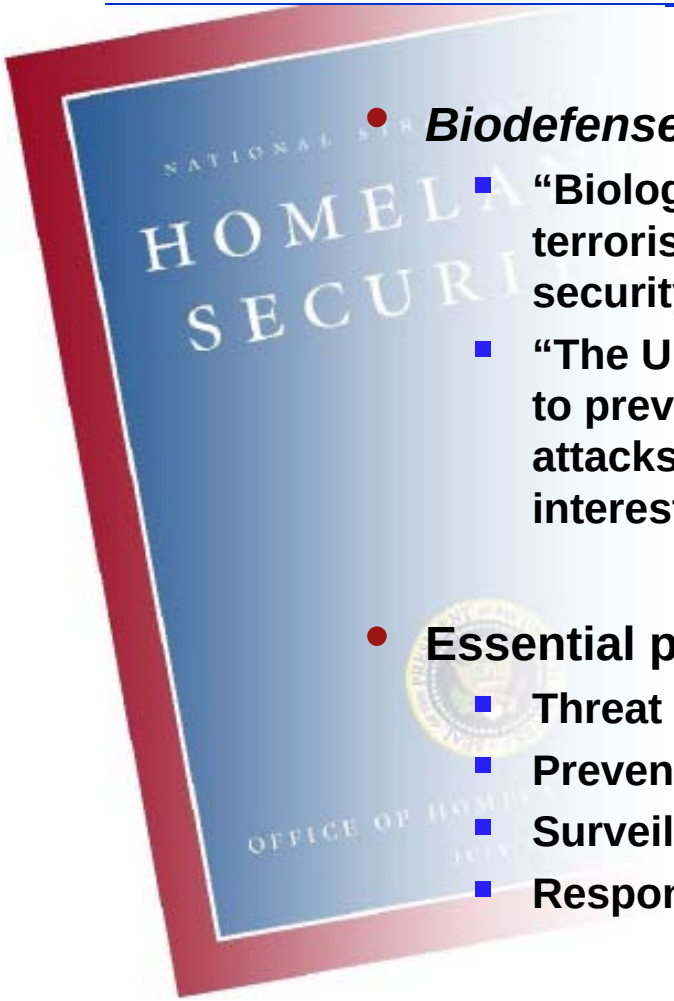
# Homeland Security Presidential Directive-10

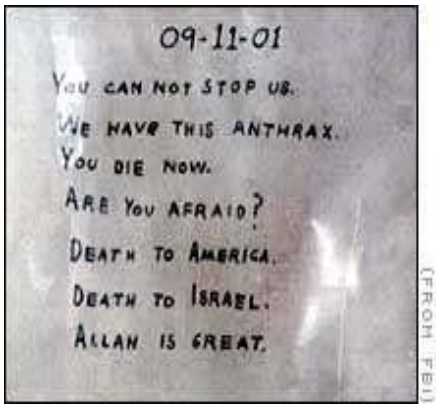



- ***Biodefense for the 21st Century (also NSPD-33)*, April 2004**
  - **"Biological weapons in the possession of hostile states or terrorists pose unique and grave threats to the safety and security of the United States and our allies."**
  - **"The United States will continue to use all means necessary to prevent, protect against, and mitigate biological weapons attacks perpetrated against our homeland and our global interests."**

- **Essential pillars of our national biodefense program are**
  - **Threat Awareness**
  - **Prevention and Protection**
  - **Surveillance and Detection**
  - **Response and Recovery**

# US Policy to Counter the Biological Weapons Threat

- **$36B since 2001**
- **Biodefense**
  - **Enhance the ability of the US to respond to the next bioterrorist attack**
  - **A *domestic* strategy designed to reduce the consequences of bioterrorism**
- **Biological weapons nonproliferation**
  - **An *international* strategy designed to prevent the development, use, and spread of biological weapons by states**

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# Biodefense

- Rapid USG biodefense budget increase
  - $1.5B in FY01
  - $6.5B/year average in FY02-05
  - $8B in FY06; $8B requested in FY07
- Broad technical applications
  - Diagnostics and disease surveillance
  - Detection and sensor technologies
  - Emergency response capabilities
  - Decontamination and remediation technologies
  - Public and agricultural health capacities
  - Vaccines and therapies

- Significant gaps exist in the short term
  - Inadequate countermeasures for all threat agents
  - Limited detection and attribution capabilities
  - Infrastructure not prepared for attack

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# Biological Weapons Nonproliferation

- **Represents only 2% of the USG budget to counter biological weapons**
  - **$61M in FY01**
  - **$127M/year average in FY02-FY06**
- **US BWNP programs have focused on bilateral engagement with countries that had offensive weapons programs**
  - **Engage Russia and the republics of the Former Soviet Union**
  - **Support and strengthen the Biological Weapons Convention**
  - **Impose export controls**

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# Evolution of the Biological Threat

- The biological threat has evolved in concert with
  - Increasing emergence and reemergence of highly infectious disease
  - Advance of biotechnology globally
  - Rise of transnational, asymmetric terrorism
- This recent "globalization" of the biological threat has broadened the availability of materials, technologies, and expertise needed to maliciously disseminate infectious disease

Mt. Merapi, Yogyakarta, Indonesia

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# Infectious Disease

- **Global outbreaks of emerging and reemerging infectious disease present a growing threat to international security**
- **Most dangerous infectious diseases are often tropical diseases that emerge in developing countries**
- **Infectious diseases now spread across borders as never before**
- **Natural outbreaks represent unpredictable sources of dangerous pathogens for terrorists**

***SARS virus***



***FMD outbreak UK***

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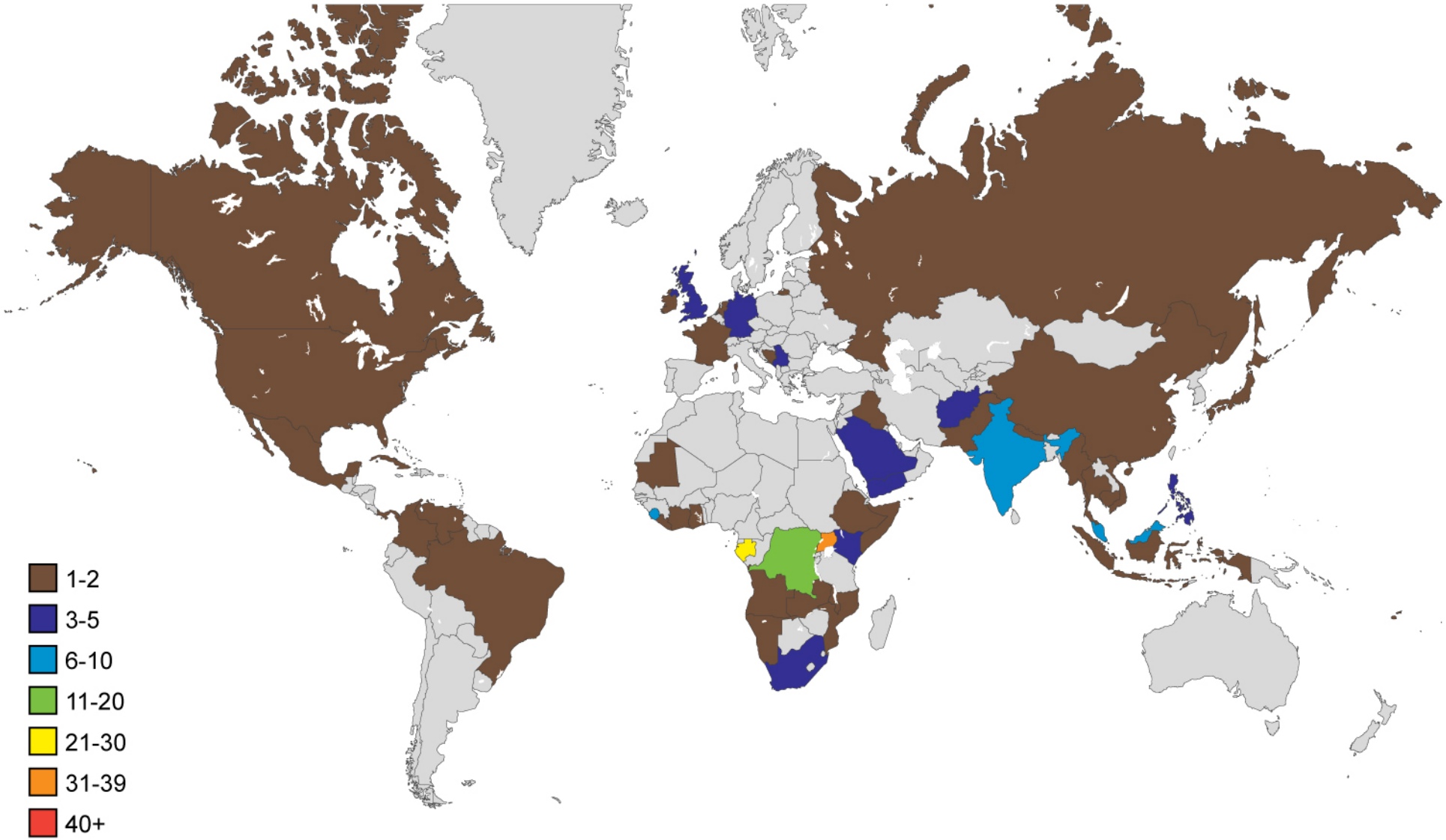
# WHO Outbreak Reports for Emerging Infectious Diseases 1996-2000



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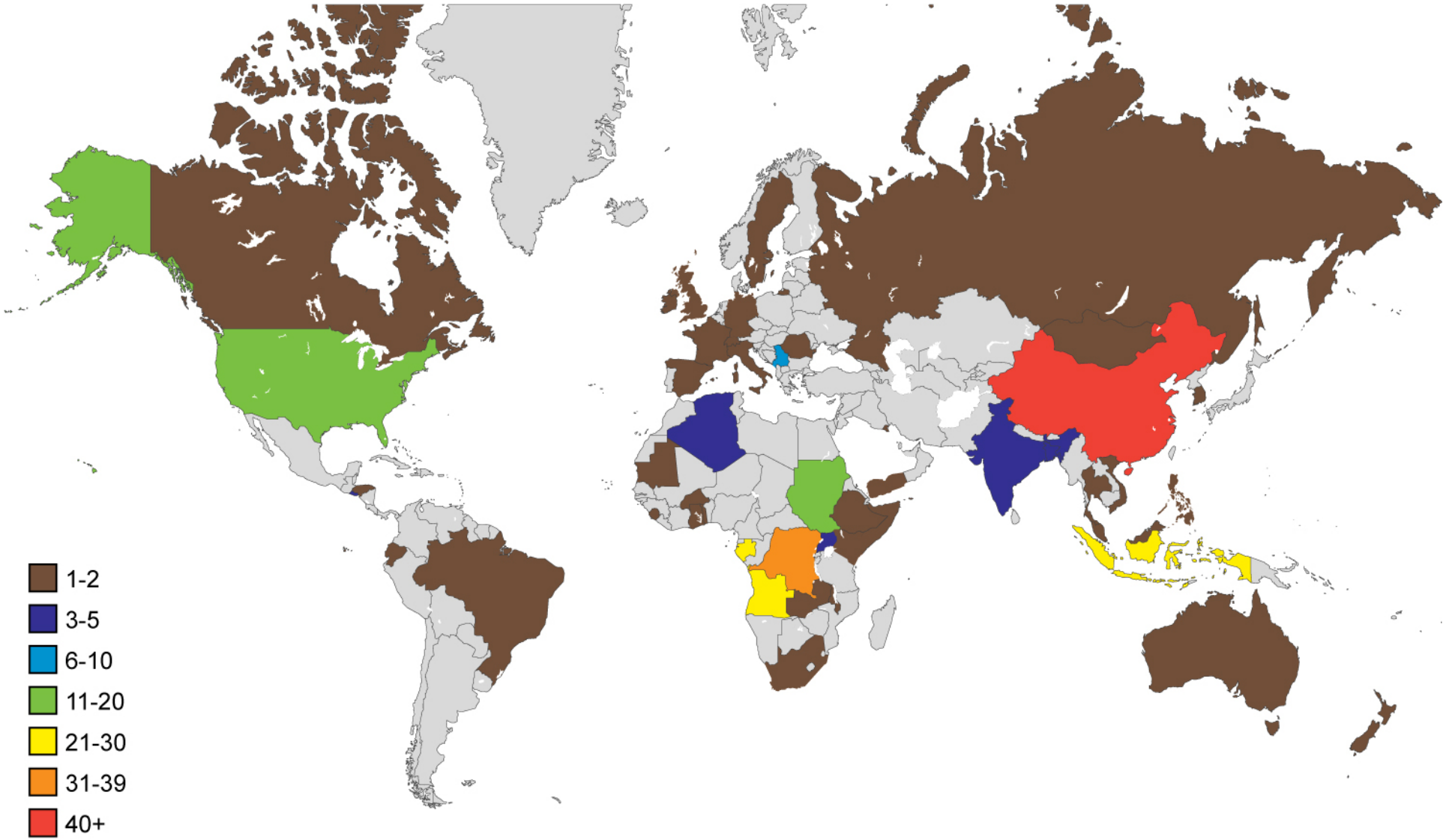
# WHO Outbreak Reports for Emerging Infectious Diseases 2001-2005



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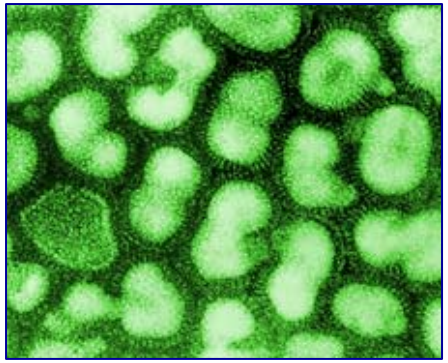
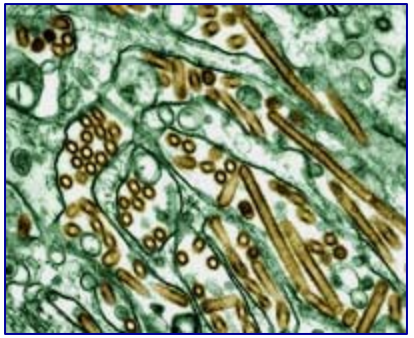
# Highly Pathogenic Avian Influenza

- **H5N1 strain of highly pathogenic avian influenza first emerged in 1997 and has spread to over 50 countries**
  - **Over 229 people infected, at least 131 fatalities**
  - **Has also infected other mammals**
- **Sequencing of the 1918 pandemic influenza virus revealed that H5N1 is very similar *(Taubenberger 2005)***
  - **Unlike the strains of the 1958, 1967 pandemics**

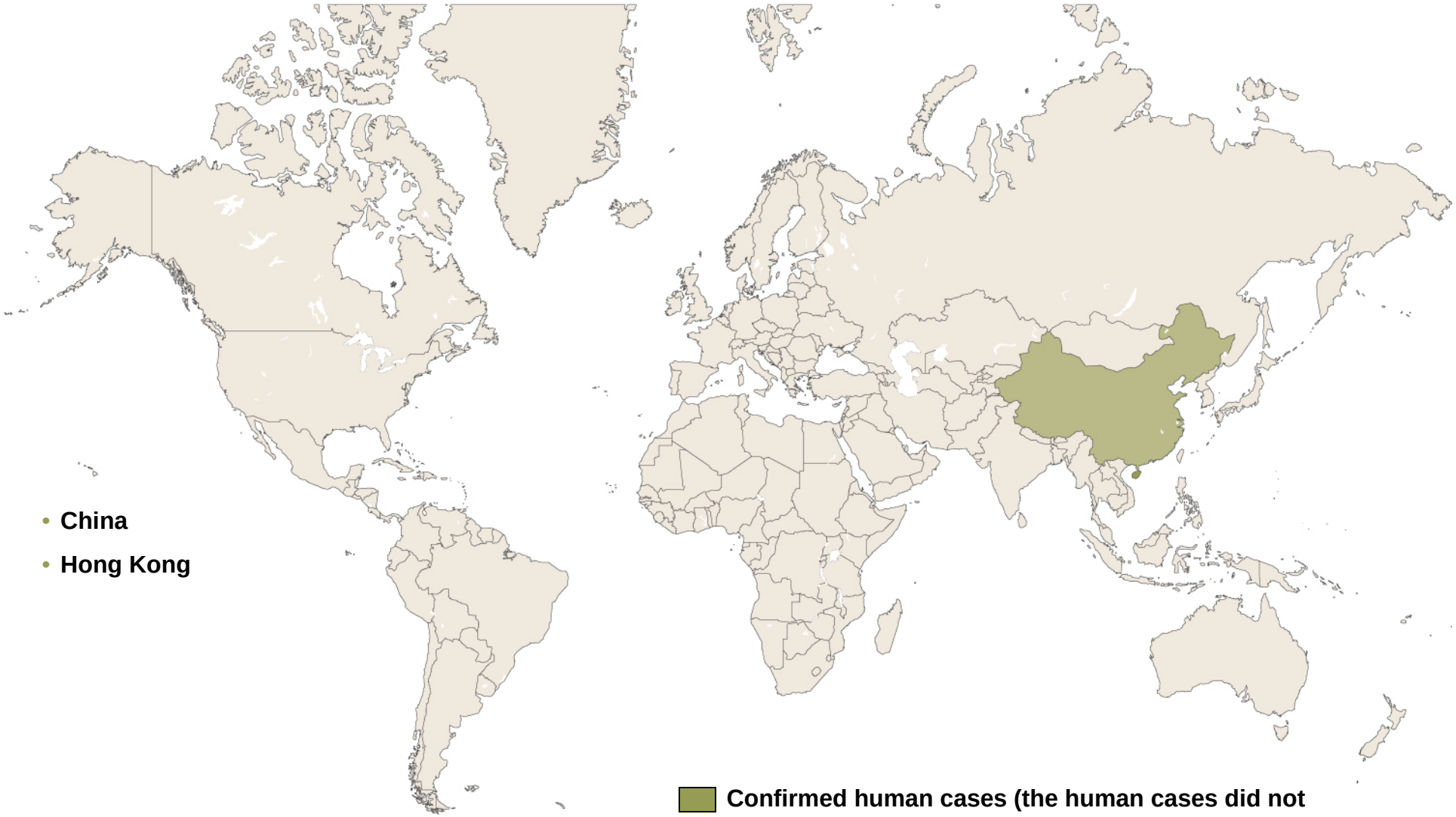


***Avian influenza virus***



- **The virus is evolving**
  - **Strain in Turkey had mutations that made it more adapted to humans than birds**
  - **Strain in Vietnam resistant to Tamiflu®**
  - **Confirmed human-to-human transmission in Indonesia**

# Highly Pathogenic Avian Influenza H5N1—1997



- China
- Hong Kong

Confirmed human cases (the human cases did not necessarily occur the year the country first reported H5N1)

Confirmed animal cases

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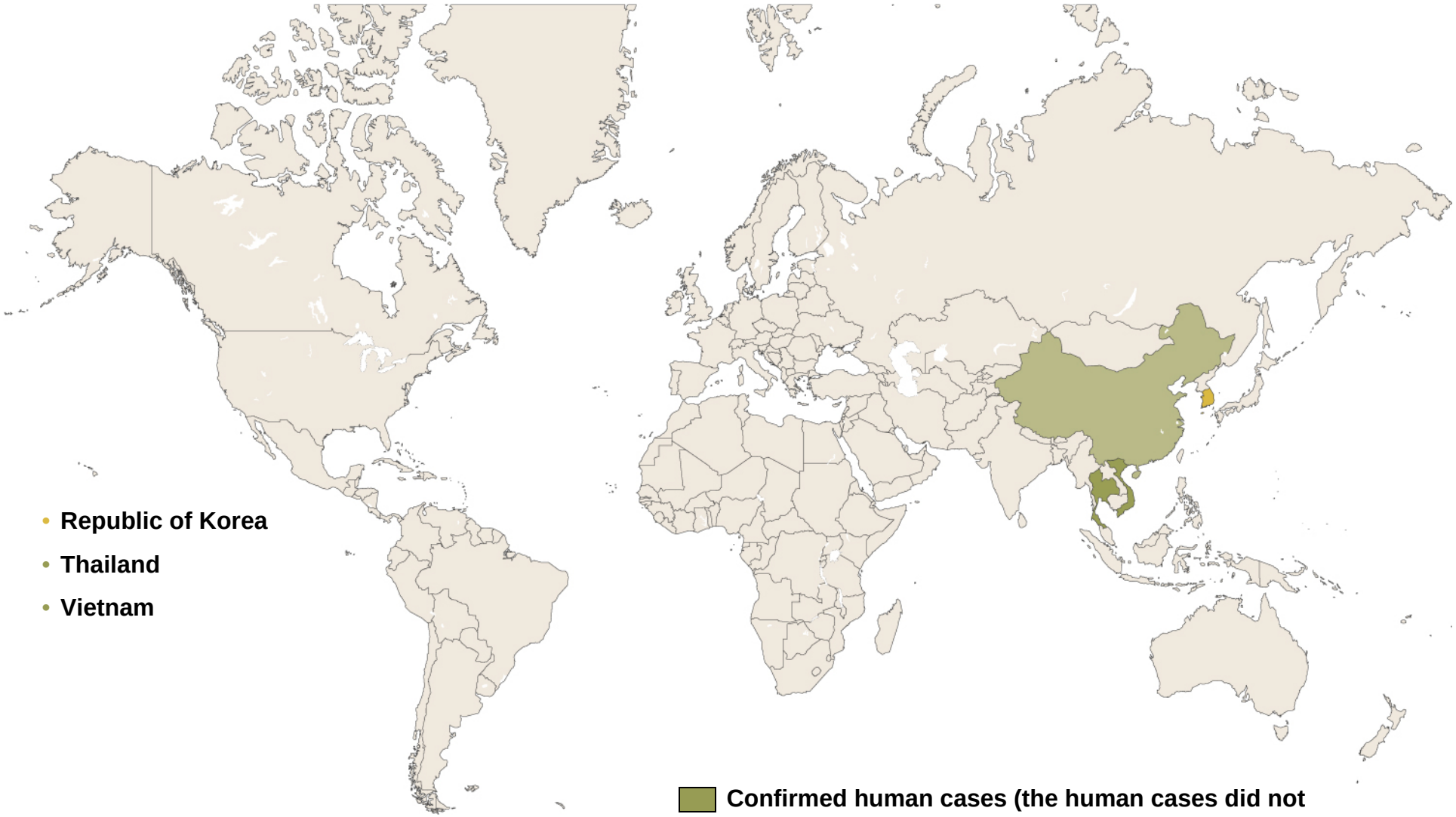
# Highly Pathogenic Avian Influenza H5N1—2003



- Republic of Korea
- Thailand
- Vietnam

Confirmed human cases (the human cases did not necessarily occur the year the country first reported H5N1)

Confirmed animal cases

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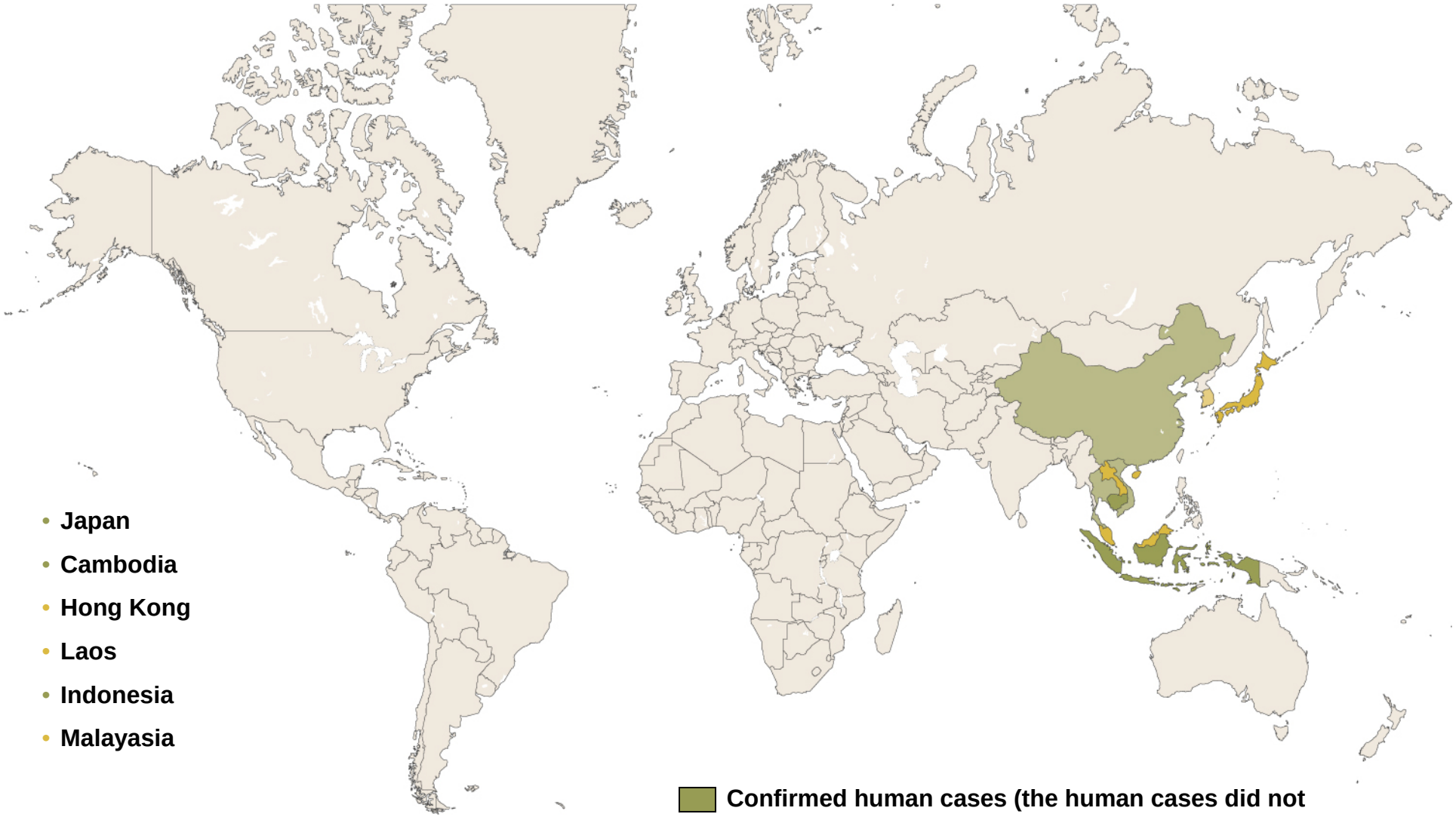
# Highly Pathogenic Avian Influenza H5N1—2004



- Japan
- Cambodia
- Hong Kong
- Laos
- Indonesia
- Malayasia

Confirmed human cases (the human cases did not necessarily occur the year the country first reported H5N1)

Confirmed animal cases

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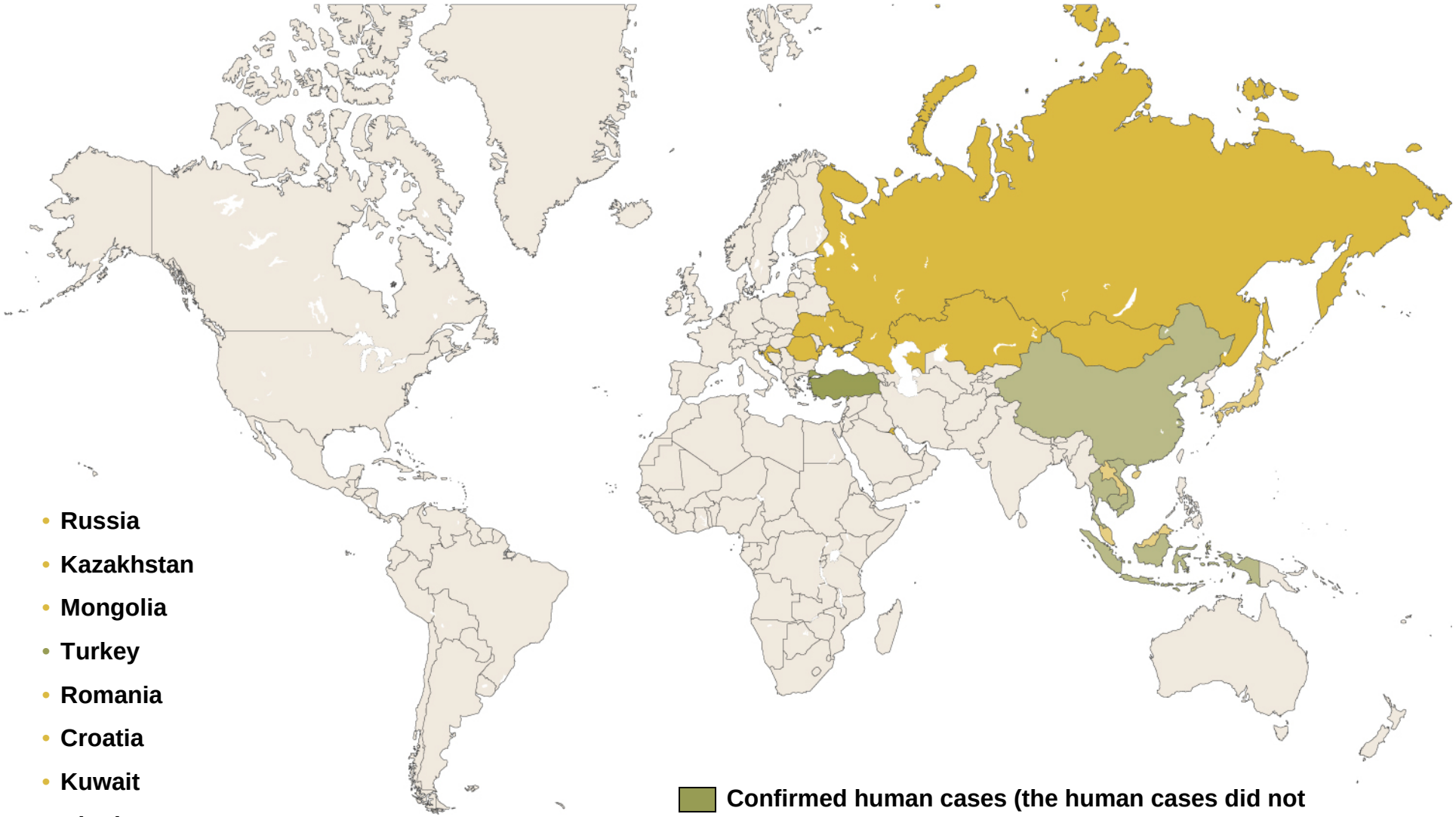
# Highly Pathogenic Avian Influenza H5N1—2005



- Russia
- Kazakhstan
- Mongolia
- Turkey
- Romania
- Croatia
- Kuwait
- Ukraine

Confirmed human cases (the human cases did not necessarily occur the year the country first reported H5N1)

Confirmed animal cases

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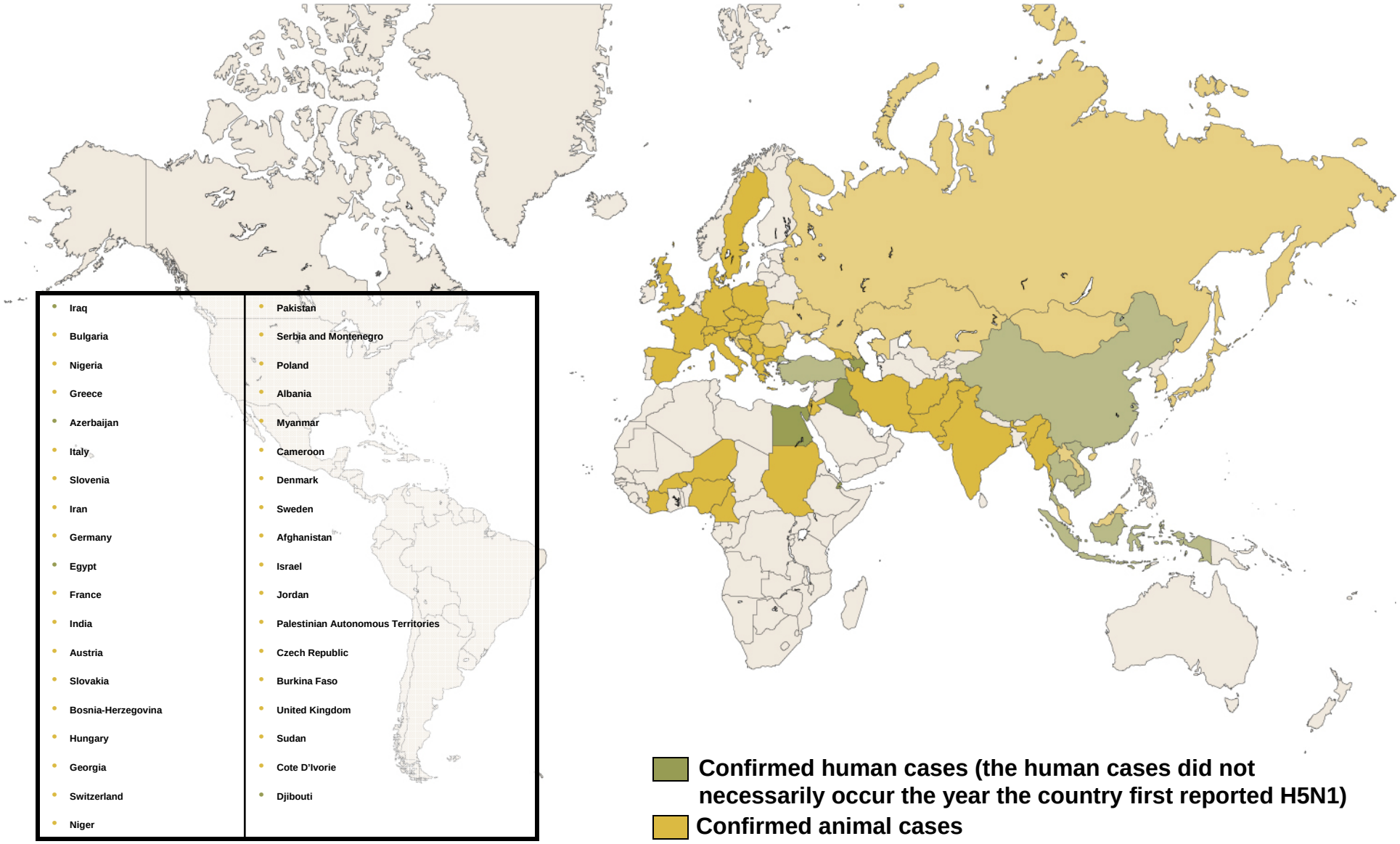
# Highly Pathogenic Avian Influenza H5N1—2006



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# Biotechnology and the Life Sciences

- Rapid expansion of bioscience worldwide is perhaps the most significant influence on the biological threat
- Viable and virulent organisms are stored and used in more legitimate bioscience facilities across the globe than ever before
- Individuals with the expertise necessary to misuse biology can be found in nearly all areas of the life sciences internationally
- The tools necessary to develop and disseminate a low-grade biological weapon are ubiquitous

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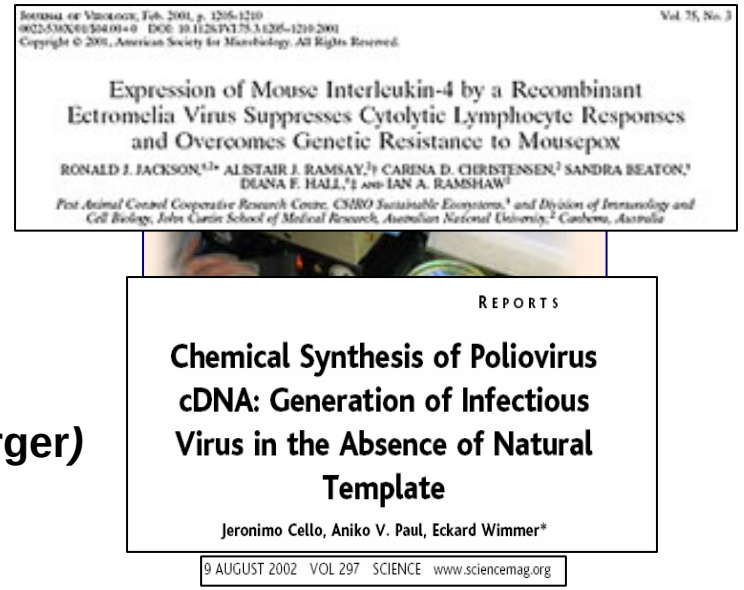
# Double-Edge Sword of Biotechnology

- **Genetic modification**
  - **2001 – IL-4 and mousepox (Australia)**
  - **2003 – IL-4 and mousepox (St. Louis)**
- **Chemical synthesis**
  - **2002 – polio virus (Stony Brook)**
  - **2003 – phi-X174 virus (Venter)**
  - **2005 – 1918 influenza virus (Taubenberger)**



Journal of Virology, Feb. 2001, p. 1205–1210 Vol. 75, No. 3
0022-538X/01/$04.00+0 DOI: 10.1128/JVI.75.3.1205–1210.2001
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Expression of Mouse Interleukin-4 by a Recombinant Ectromelia Virus Suppresses Cytolytic Lymphocyte Responses and Overcomes Genetic Resistance to Mousepox

RONALD J. JACKSON,[1,2]* ALISTAIR J. RAMSAY,[2]† CARINA D. CHRISTENSEN,[2] SANDRA BEATON,[2] DIANA F. HALL,[2]‡ AND IAN A. RAMSHAW[1]

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REPORTS

Chemical Synthesis of Poliovirus cDNA: Generation of Infectious Virus in the Absence of Natural Template

Jeronimo Cello, Aniko V. Paul, Eckard Wimmer*

9 AUGUST 2002 VOL 297 SCIENCE www.sciencemag.org

- **Advance of biotechnology will ease**
  - **Acquisition barriers**
  - **Production barriers**
  - **Dissemination barriers**

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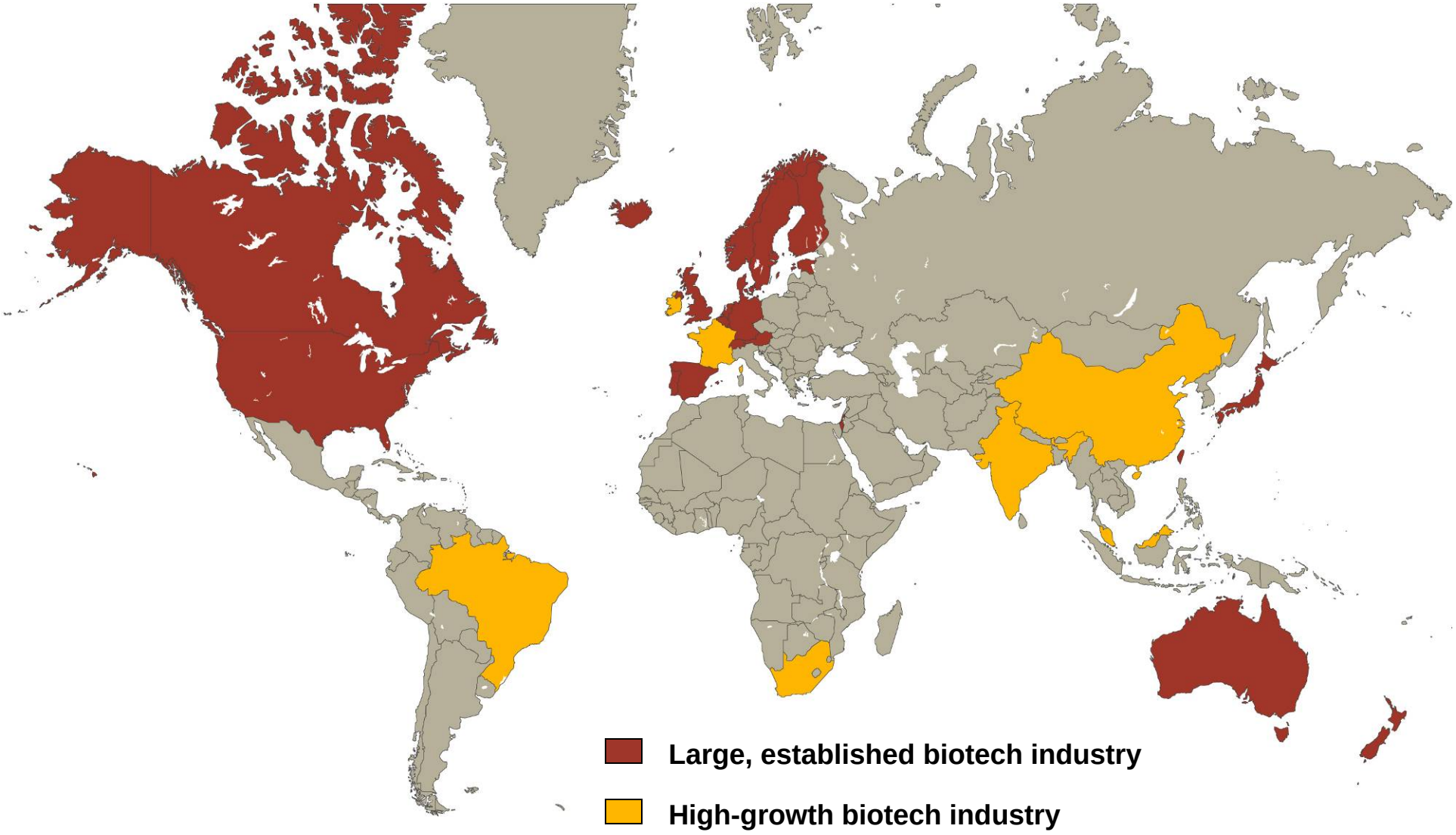
# Large Biotechnology Industry and Clusters of Expertise, 2004-2005




http://mbbnet.umn.edu/scmap/biotechmap.html

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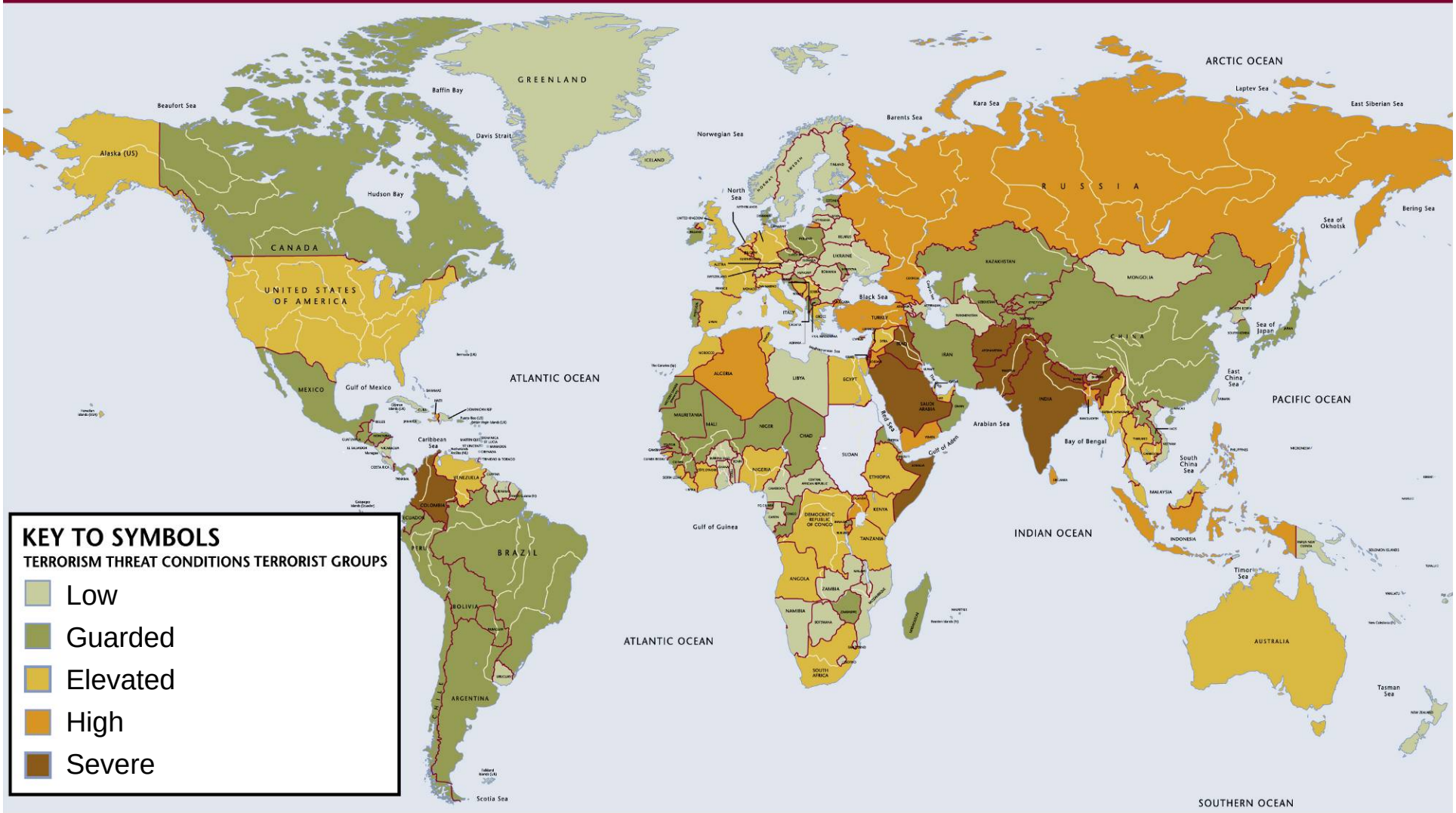
# Transnational Terrorism

- Well financed and sophisticated terrorism has risen sharply over the last 15-20 years
- Terrorists engage in asymmetric warfare – employing unconventional tactics which experts believe will increasingly focus on acquiring and using WMD
- Terrorists are active in regions with expanding biotechnology and outbreaks of infectious disease
- Al Qaeda has repeatedly expressed interest in biological weapons
  - Osama bin Laden (1998): acquiring WMD is a "religious duty"
  - December 2001: cache of technical books, journal papers, rudimentary equipment found at abandoned training camp near Kandahar


# Global Terrorism Risk




http://www.aon.com/risk_management/terrorism_mitigation/terrorism_risk_map.jsp

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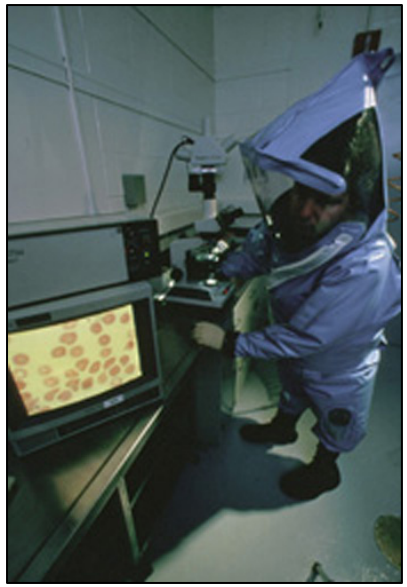
# Challenges to Preventing Bioterrorism

- **Experts believe that the bioterrorist threat is more significant than the state BW proliferation threat**

- **Building blocks for biological weapons are dual use**
  - **Materials**
  - **Technologies**
  - **Expertise**

- **Attempts to control biological expertise, information, equipment, and technology would stymie the advance of science and harm the fight against infectious diseases**



- **Limiting step for most bioterrorists is acquiring the viable and virulent pathogen**
  - **Dangerous pathogens are widely distributed but tend to exist in specific natural environments, facilities and transport systems**

- **Legitimate bioscience must continue to work with dangerous pathogens**
  - **Protecting legitimate bioscience globally is a critical prevention measure to reduce the bioterrorist threat**

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# US Domestic Efforts to Reduce Access to Dangerous Biological Materials

- Realization that bioscience facilities are potential sources of biological weapons material
- USA PATRIOT Act of 2001 – US Public Law 107-55
  - Restricted Persons
- Bioterrorism Preparedness Act of 2002 – US Public Law 107-188
  - US Select Agent Rule
  - Hazardous Material transport security
- No international standards for managing dangerous pathogens internationally

*National Animal Disease Center, Ames, Iowa*

*Centers for Disease Control and Prevention, Atlanta, Georgia*

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# International Biological Threat Reduction at Sandia

- **Program objective: Mitigate biological risks caused by highly infectious disease agents—internationally**
  - **Enhance safety and security of dangerous pathogens and toxins in legitimate bioscience operations**
  - **Strengthen capacities to detect and control infectious disease**

- **Technical implementation**
  - **Agent risk assessment to identify high risk agents**
  - **Laboratory biosecurity and biosafety to address pathogens in specific facilities**
  - **Transport biosecurity and biosafety to address pathogens in transit**
  - **Pathogen and disease surveillance to identify outbreaks of disease caused by high risk agents**
  - **Modern molecular diagnostics to accelerate detection and to reduce the reliance on live pathogens**
  - **Outbreak control measures to control natural sources of high risk agents**

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# Current US International BWNP Efforts

- **Russia, the Newly Independent States, Iraq, and Libya**
  - **Executed by the Departments of State and Defense**

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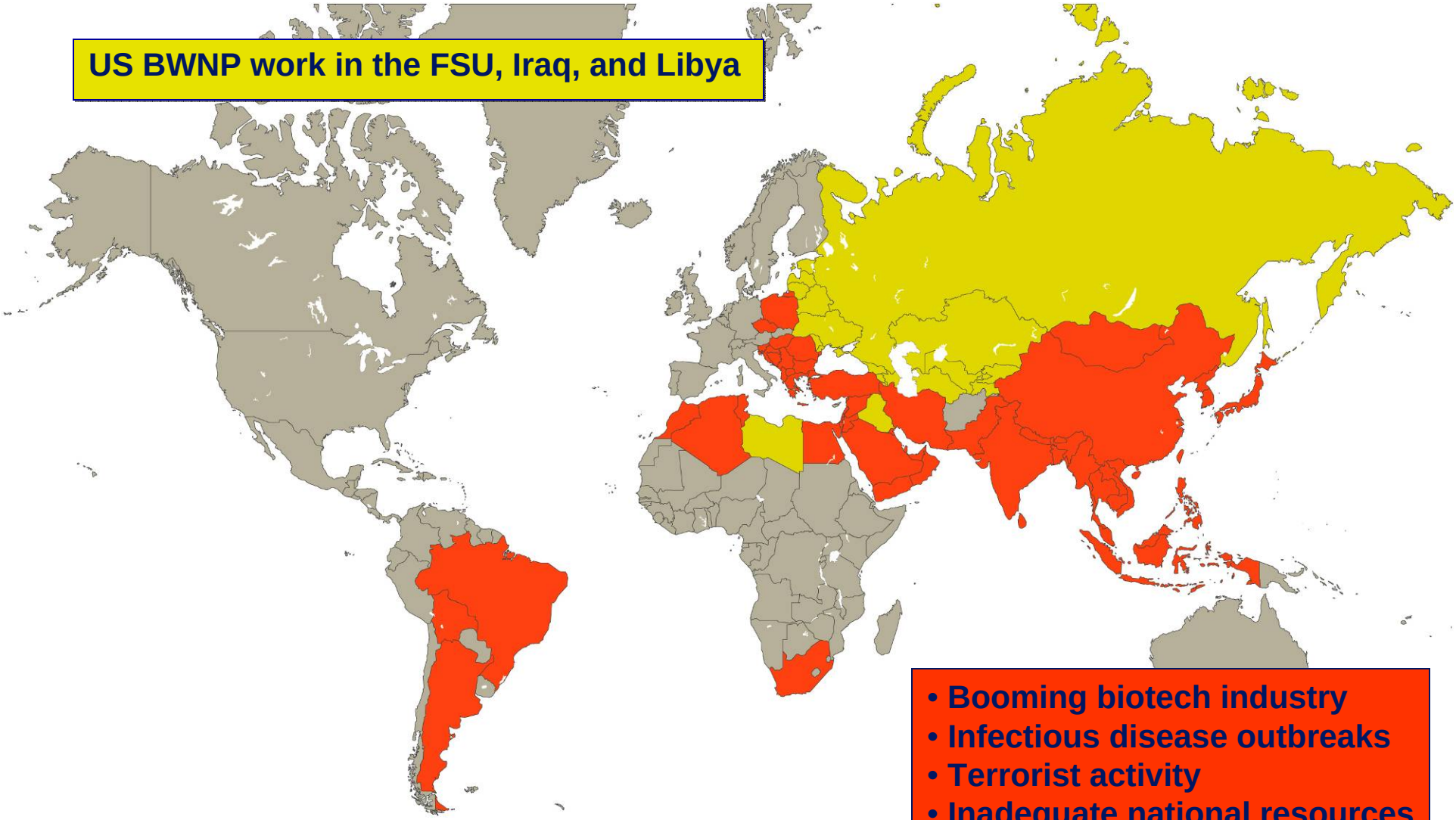
# Sandia Bioscience Risk Assessment

**US BWNP work in the FSU, Iraq, and Libya**



- **Booming biotech industry**
- **Infectious disease outbreaks**
- **Terrorist activity**
- **Inadequate national resources**
- **Government instability**

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# New Department of State Program in 2006

- **DOS Biosecurity Engagement Program concerned about terrorists exploiting legitimate bioscience to pursue bioterrorism**
  - **Not looking for state-based offensive weapons programs, weapons caches, or terrorists developing weapons**
- **DOS working with legitimate bioscientists and law enforcement officials around the world to**
  - **Ensure safe and secure use of dangerous biological agents**
  - **Strengthen capacities to detect and control infectious disease**
- **Method: build relationships, share technical expertise, and promote good practices**


***New Department of State Global Program (www.bepstate.net)***

***US national security interest to help international community manage dangerous pathogens and control infectious disease***

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# Summary

- US Government focuses on improving our ability to *respond* to the next bioterrorist attack at home
  - Much less emphasis on *preventing* bioterrorism attacks
- The biological threat has evolved in concert with
  - Increasing emergence and reemergence of highly infectious disease
  - Advance of biotechnology globally
  - Rise of transnational, asymmetric terrorism
- Evolution of the threat has compelled the US Government to develop new policies and programs that focus on protecting dangerous pathogens and strengthening legitimate bioscience worldwide
- Sandia is playing a leading role in this new and growing field
  - Sandia technical expertise should continue to expand and diversify to meet this challenge